

# Claims

1. (Amended) A three-dimensional periodic structure, wherein said structure is fabricated by forming layers with at least two kinds of materials sequentially and periodically on a substrate having two-dimensionally periodically recessed or projecting portions, and by employing sputter etching separately from film deposition or simultaneously with film deposition, at least in a part of said forming, while keeping a pattern of the recessed or projecting portions.

2. (Amended) A method of fabricating a three-dimensional periodic structure by forming layers with at least two kinds of materials sequentially and periodically on a substrate having two-dimensionally periodically recessed or projecting portions, and by employing sputter etching separately from film deposition or simultaneously with film deposition, at least in a part of said forming, while keeping a pattern of the recessed or projecting portions.

3. (Amended) A three-dimensional periodic structure, wherein said structure is fabricated by forming layers with at least two kinds of materials sequentially and periodically on a substrate having two-dimensionally periodically recessed or projecting portions, and by carrying out deposition characterized by diffuse incidence of particles at least in a part of a period, and sputter etching at least in a part of a period, while keeping a pattern of the recessed or projecting portions.

4. (Amended) A method of fabricating a three-dimensional periodic structure by forming layers with at least two kinds of materials sequentially and periodically on a substrate having two-dimensionally periodically recessed or projecting portions, and by carrying out deposition characterized by diffuse incidence of particles at least in a part of a period, and sputter etching at least in a part of a period, while keeping a pattern of the recessed or projecting portions.

5. (Amended) A three-dimensional periodic structure, wherein said structure is fabricated by sequentially and periodically forming at least two kinds of layers including a layer mainly comprising  $\text{SiO}_2$  and a layer mainly comprising Si on a substrate having two-dimensionally periodically recessed or projecting portions, and by carrying out sputter etching and sputter deposition alternatively or simultaneously at least in a part of said forming, while keeping a pattern of the recessed or projecting portions.

6. (Amended) A method of fabricating a three-dimensional periodic structure by sequentially and periodically forming at least two kinds of layers including a layer mainly comprising  $\text{SiO}_2$  and a layer mainly comprising Si on a substrate having two-dimensionally periodically recessed or projecting portions, and by carrying out sputter etching and sputter deposition alternatively or simultaneously at least in a part of said forming, while keeping a pattern of the recessed or projecting portions.

7. (Amended) A method of fabricating a film, wherein one or more holes and/or grooves are provided on a substrate, and then, said holes and/or grooves are shaped more deeply or bend portions of said holes and/or grooves are shaped more sharply by carrying out a process on said substrate, said process including deposition characterized by diffuse incidence of particles at least in a part thereof, and sputter etching at least in a part thereof, while keeping a pattern of the recessed or projecting portions.

8. (Amended) A method of fabricating a film, wherein one or more holes and/or grooves are provided on a substrate, and then on said substrate, is carried out a process including deposition characterized by diffuse incidence of particles at least in a part thereof, and sputter etching at least in a part thereof, thereby said holes and/or grooves are changed to cavities, while keeping a pattern of the recessed or projecting portions.

9. A structure, wherein a material having a nonlinear optical susceptibility, an electrooptic material, a transparent material, or a conductive material is included at least in a part of a three-dimensional periodic structure in which at least two kinds of film materials having two-dimensionally periodically recessed or projecting portions are sequentially and periodically formed according to the method of Claim 2, 4, or 6, or in an interface of films of a three-dimensional periodic structure having such structure that one or more kinds of film materials having two-dimensionally periodically recessed or projecting portions are periodically formed.

10. A structure, wherein a light emitting or light amplifying material is included in at least a part of a three-dimensional periodic structure comprising at least two kinds of transparent bodies fabricated by the method of Claim 2, 4, or 6.

11. (Amended) A structure, wherein a waveguide, a resonator, a branch, a coupler, or a reflector, is included, and arranged in line, in a plane, or three-dimensionally, inside a three-dimensional periodic structure having such structure that at least two kinds of transparent films having two-dimensionally periodically recessed or projecting portions are sequentially and periodically formed, while keeping a pattern of the recessed or projecting portions.

12. A structure which includes a semiconductor laser or an optical detector inside a three-dimensional periodic structure comprising at least two kinds of transparent materials and fabricated by the method of Claim 2, 4, or 6.

13. (Amended) 13. A transparent three-dimensional periodic structure showing optical biaxial anisotropy, wherein on a substrate having two-dimensionally periodically recessed or projecting portions with orthogonal x- and y-axes on the substrate as axes of symmetry, at least two kinds of transparent films having a pattern of periodically recessed or projecting portions common to said substrate are formed sequentially and periodically, while keeping a pattern of the recessed or

projecting portions.

14. A method of fabricating a diffraction grating which comprises a plurality of layers having diffraction effects which comprises a film being of the same kind of material as a substrate and having grooves coincident with the substrate in pattern of recessed portions, and a second transparent material mainly filled in the grooves, and is formed on a transparent substrate having an array of one-dimensionally periodic grooves or of two-dimensionally periodic grooves with finite lengths, said fabrication utilizing deposition characterized by diffuse incidence of particles at least in a part of said forming, and sputter etching at least in a part of said forming.

15. (Amended) An optical diffraction grating, comprising a plurality of layers having diffraction effects which comprises a film being of the same kind of material as a substrate and having grooves coincident with the substrate in pattern of recessed portions, and a second transparent material mainly filled in the grooves, and is formed on a transparent substrate having an array of one-dimensionally periodic grooves or of two-dimensionally periodic grooves with finite lengths by carrying out deposition characterized by diffuse incidence of particles at least in a part of said forming, and sputter etching at least in a part of said forming.

16. A transparent three-dimensional periodic structure showing optical biaxial anisotropy, in which structure at least two kinds of film materials having two-dimensionally periodically recessed or projecting portions are sequentially and periodically formed according to the method of Claim 2, 4 or 6.

17. A transparent three-dimensional periodic structure showing dispersion near a forbidden frequency bandgap, in which structure at least two kinds of transparent film materials having two-dimensionally periodically recessed or projecting portions are sequentially and periodically formed.

18. A transparent three-dimensional periodic structure showing dispersion near a forbidden frequency bandgap, in which structure at least two kinds of transparent film materials having two-dimensionally periodically recessed or projecting portions are sequentially and periodically formed according to the method of Claim 2, 4, or 6.

add  
C17